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R.A.	Decl.	Obs.	R.A.	Decl.	Obs.
h m s	° ′ ″		h m s	° ′ ″	
3 22 9·63	+10 48 56·4	2	3 35 12·88	+10 41 50·4	
22 13·85	9 56 11·1		35 42·96	11 21 8·8	2
22 32·55	12 24 55·7		35 53·73	8 34 4·2	
23 35·27	8 14 42·1		36 19·67	10 39 24·8	
24 13·05	10 13 6·6	3	36 24·70	9 42 26·4	
25 33·53	9 10 15·1		36 29·75	11 26 3·4	2
26 13·93	8 9 6·8		37 13·51	12 45 55·4	
26 48·94	10 32 12·2		37 52·08	10 4 20·4	
27 1·69	10 53 19·9		37 56·64	12 39 56·6	
28 18·58	9 40 55·6	5	38 18·67	11 3 40·7	
28 23·32	12 47 16·4	5	38 32·52	10 42 42·1	
28 34·90	9 17 48·6		38 33·07	11 11 46·0	
29 58·77	8 38 55·0	2	38 43·44	12 38 7·2	
30 55·81	10 35 36·0	2	39 4·04	12 2 11·1	
31 16·56	8 34 8·1	2	39 59·61	10 40 28·6	3
31 45·71	11 37 46·7		41 6·28	12 26 40·1	
31 47·97	12 42 14·7		41 23·57	12 8 12·8	
32 8·70	12 35 43·6		41 28·26	10 5 39·7	
32 10·83	13 3 37·3		42 53·06	12 35 8·4	
32 13·33	10 31 59·2		43 22·88	10 23 1·9	
32 58·68	10 39 37·7		44 33·61	9 31 23·6	
33 11·90	12 48 27·9		46 2·99	8 47 51·1	2
33 19·84	9 35 33·1		50 20·32	10 35 26·5	
34 29·17	8 8 57·3		52 19·15	12 3 34·0	
34 34·03	11 28 25·3		3 55 56·10	+12 5 17·5	
3 34 41·86	+12 34 6·4				

Mean Places for January 1, 1850.

R.A.	Decl.	R.A.	Decl.
h m s	° ′ ″	h m s	° ′ ″
2 44 50·07	+7 59 29·0	2 48 24·51	+9 30 56·8
45 43·22	8 43 12·2	48 56·37	9 33 27·0
2 47 19·72	+8 42 58·9	2 51 44·01	+9 54 7·8

The small figure at the end denotes the number of observations. Where there is no number, only one observation has been made.

On the Phenomena attending the Disappearance of Saturn's Ring.

By the Rev. W. R. Dawes.

"The interesting phenomena attending the disappearance of *Saturn's* ring in 1848, can scarcely have failed to attract the attention of the possessors of powerful telescopes in this country; but none, I believe, of the observations made have been presented to the Astronomical Society. From Professor Bond, however, a paper appears in the *Monthly Notices* for November 1849, containing

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observations made on *Saturn* with Merz's large refractor at Cambridge, U. S.; and also some inferences which he deduces from them.

"My own refractor (then at Cranbrook) being employed on a regular series of micrometrical observations, was only occasionally turned on the planet. What was noticed, however, was usually recorded at the time in my observatory journal, though without any intention of publication; for it was imagined that the results of observations with far more powerful telescopes, reflecting and refracting, would doubtless appear in the *Monthly Notices*, and render my own superfluous. On a perusal of Professor Bond's paper, however, I find that I have noticed several interesting particulars not alluded to by him; and also that the deductions I have drawn from some of the phenomena observed by both of us differ greatly from his. I, therefore, beg to present to the Society the following extracts from my journal, with some remarks upon them.

"'1848, June 30. *Saturn*. Power 252. The *ansæ* of the ring are *not quite* invisible. They are of a *deep coppery tinge;* and on the following arm is a faint satellite. I get an occasional glimpse of a similar appearance on the preceding arm, but cannot decidedly verify it. The planet is more than 2½ hours east of the meridian. On looking again carefully with powers 252 and 163, I cannot be certain of either of the points *upon* the ring; for the *ring itself* seems *brighter* in those parts; and I question whether it be not a small portion of the ring which reflects more light. On estimating carefully, I find the part must be about *the extremity of the inner ring*, which is its brightest part.

"'July 15. The ring is visible, *with the two dots* [bright points] *on it as before.*

"'August 9. Occasionally an exceedingly faint *dusky red* line extends on each side of the shadow on the ball [being the arms of the ring].

"'August 20. The shadow of the ring on the ball is very narrow. *The arms of the ring not visible.*

"'Sept. 1. Power 163. Excessively narrow shadow of the ring on the ball. Belts strong, especially the two parallel ones in the northern hemisphere. *No trace of the ring.*

"'Sept. 2. 11^h G. M. T. Power 163. *The ring is visible* as an excessively narrow line *of nearly the same colour as the planet.* The *Nautical Almanac* gives *Sept.* 3 as the time of its reappearance. *No shadow* on the ball.

"'Sept. 3. Power 188 [an equiconvex single lens]. The ring is bright, though rather duller in colour than the planet. There is a dusky line about the same degree of shade as the belts (which are strong to-night), crossing the ball precisely in the line of the ring. It is very different from the *shadow* of the ring. Is it the *ring itself*, which, being less bright than the planet, is visible on the ball; as *Jupiter's* third and fourth satellites are visible on his

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disk as they transit over it? Night fine. *Enceladus* very well seen, and watched nearly up to the preceding arm.

"'Sept. 4. Ring much brighter than last night. The dusky shade across the ball is visible, but not so distinct as it was last night. The following arm appears decidedly longer than the preceding one."

"A few days after the last observation, I went to Starfield on a visit to Mr. Lassell, and on every opportunity that offered observed *Saturn* with his powerful 20-foot reflector. The following are some of the memoranda entered in my journal.

"'Sept. 12. $11^h 20^m$ M.T. The ring is the finest line imaginable, yet of a pretty clear bright planetary colour.

"'Sept. 13. *No ring visible, nor shadow.*

"'Sept. 14. No ring visible. There is a very narrow dusky line [on the ball] just south of the bright equatoreal region.

"'Sept. 19. The ring is *just visible* when the planet is best seen.' [It was frequently noticed to-night during the series of observations which placed beyond doubt the satellite-nature of *Hyperion*.]

"The subsequent observations were made after my return to Camden Lodge, Cranbrook, with my 8½-foot achromatic.

"'Oct. 6. No decided appearance of the ring on either side. $9^h 45^m$, *Tethys* has occulted *Enceladus*. The planet is exquisitely seen. The line across the ball is very sharply defined and black, though I thought not quite *uniformly* so; the northern edge appearing blacker than the southern. [The *obscure* surface is now turned towards the earth.]

"'Oct. 11. The arms of the ring are *frequently visible*, especially that on the *following* side, which is far more steadily seen than the other.

"'Oct. 26. Exquisite vision. Glimpses of a *division in the dark shade on the ball.*

"'Oct. 30. I have several times this evening received the impression of the dark line across the ball being *divided by an excessively fine line of light*, perhaps a trifle north of its middle. Most frequently suspected with powers 323 and 460.

"'$11^h 30^m$. *Enceladus* is at the end of the following arm very nearly. There is a pretty bright dot *on* the following arm, and a similar one on the preceding arm.'*

"'Nov. 21. Very fine night. *Enceladus* was seen the instant the object was brought into the field of the *double-image* micrometer, power 435; and when the image was divided, the two points were still distinctly visible; proving that the telescope will

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* The night of Oct. 30 was very fine. *Enceladus* was bright with power 460, and was easily watched nearly up to contact with the following arm of the ring. Its distance from the planet's centre was measured with the parallel-wire micrometer under slight illumination of the field. At $7^h 16^m 30^s$ G.M.T. the distance was $34''\cdot40$ by four observations. With 460 and 658 the two bright satellites of *Uranus* were steadily seen.

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shew a lucid point of *half the brightness of Enceladus.* The dark shade [on the ball] is occasionally seen *divided by a bright and excessively narrow line.* The planet bears 460 very well.

" 'Dec. 5. The ring is curiously broken into portions, which look almost like small satellites. Occasionally, the planet is very well seen.

" 'Dec. 20. The ring is obvious enough, but is broken, especially on the following side.

" 'Dec. 21. The ring is reduced to a very fine line, occasionally appearing broken, but sometimes entire. The eastern arm is not quite so bright as the western.

" '1849, Jan. 6. The ring is scarcely ever visible, but occasionally in the best moments it may be traced nearly or perhaps quite to the extremity. But some portions of it are brighter than others.'

" At this time the earth was elevated about half a degree to the *north* above the plane of the ring; the sun being about 1°·8 to the *south* of that plane. On the 19th, the earth passed from the northern to the southern side of the plane of the ring; and the *bright* surface became visible. Cloudy weather precluded observations till the 22d.

" 'Jan. 22, 7^h 12^m. *Titan* is in contact with the southern side of the following arm, and about two-thirds of its length from the edge of the planet. The *ring* is bright, though narrow. *It is very much brighter in two places similarly situated on each arm;* and they coincide with the extremities of the inner and outer ring.'

" *Titan* was distinguishable from the brighter parts noticed when observed at 7^h 12^m. It afterwards came into coincidence with those on the following arm as it moved along it."

Remarks.

" 1. From the observations above detailed, it is obvious, that when the *obscure* side of the ring is turned towards the earth, it is not invisible with moderate optical power. It also appears that *its visibility diminished* as the earth approached its plane, and its edge, consequently, was turned directly towards us. This is proved by the increased *difficulty* of seeing it with my refractor on Aug. 9, compared with July 15; between which dates the minor axis of the ring had considerably diminished; by its *invisibility* on Aug. 20 and Sept. 1, when the earth was very nearly in the plane of the ring; and by the increasing *facility* with which it was observed between Oct. 11 and the end of November, during which interval the minor axis had increased. And it is still more conclusively shown by the *total invisibility* of the ring even with Mr. Lassell's 20-foot reflector on Sept. 13th, when both the earth and the sun were very nearly in the plane of the ring, and consequently the sun's light would be reflected from its *edge* with scarcely any obliquity.

" Hence it may be inferred that the *edge* of the ring reflects extremely little light, and that the visibility of the ring, when its

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obscure side is turned towards the earth, does not arise from the sun's light reflected from the *edge*, but from a feeble illumination of the *obscure surface;* and that it is *this surface only* which is seen, and not the edge.

" This conclusion is supported by the appearance of *bright points* in some parts of the ring when obscurely visible; those points remaining *stationary*, and not partaking of the rotation of the ring. That inequalities should exist on the *edge* of the ring so large as to appear like satellites, even with a moderate telescope, when the edge itself, though directly turned towards us and fully illuminated, was quite invisible with a reflector of 24 inches aperture (whose illuminating power is about equal to that of an achromatic refractor of 17 inches aperture), seems to be quite inadmissible.

" It may be inferred, therefore, that the appearance of bright points in the unilluminated ring arises from the greater reflective power of some portions of its *surface:* the exterior portion of the inner ring being usually the largest and brightest of all, and visible on both arms at equal distances from the ball. The brightness of these points was not always precisely the same on each side: at some times the eastern, and at other times the western, appearing the brighter. This may readily be accounted for by supposing that the ring, at a given distance from its centre, may not possess the same degree of reflective power throughout its whole circuit: indeed, it is scarcely probable that it should; and the observed fact is in perfect harmony with the *rotation* of the ring, which the stationary appearance of irregularities on the *edge* can scarcely be.

" 2. The inquiry is interesting, *Whence is the light derived which renders the obscure surface of the ring visible?*

" On this subject Sir W. Herschel says (in a paper read before the Royal Society, Nov. 12th, 1789), ' I may venture to say, that the ring cannot possibly disappear on account of its thinness; since, either from its edge, or the sides, even if it were square on the corners, it must always expose to our sight some part which is illuminated by the rays of the sun: and that this is plainly the case we may conclude from its being visible in any telescopes during the time when others of less light had lost it, and when evidently we were turned towards the unenlightened side; so that we must either see the rounded part of the enlightened edge, or else the reflection of the light of *Saturn* upon the side of the darkened ring, as we see the reflected light of the earth on the dark part of the new moon. I will, however, not decide which of the two may be the case, especially as there are very strong reasons to induce us to think that *the edge of the ring is of such a nature as not to reflect much light.*'

" Relinquishing then the idea of the visibility of the mere edge of the ring (whether from its extreme thinness or its unreflective nature), it may be asked, ' Do the appearances warrant the conclusion, that the obscure surface is rendered visible by the reflexion to us of the light reflected upon it by *Saturn?*'

" If this were the case, might we not reasonably expect that its

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colour would be somewhat similar to that of the obscure portion of the moon as enlightened by the earth? It is, however, of a totally different hue, and strongly resembles the *tarnished copper* colour frequently assumed by the moon under a total eclipse. May it not also be fairly questioned whether the ring would be so brilliantly illuminated by the reflected light of *Saturn* (which must fall but feebly on the half of the ring farthest from the sun), as to cause small portions of it to rival in brightness the satellites themselves illuminated by the direct rays of the sun: the brightest points of the ring (the eastern and western extremities) receiving reflected light from *one-half only* of the illuminated surface of *Saturn*, which would be seen from them as a *half-moon*?

"I would venture, therefore, to suggest, that the illumination of the obscure surface of the ring arises from the *refraction of the sun's light through an atmosphere surrounding each of the rings*, and thus throwing a pretty strong *twilight* upon them. During the whole time that the obscure surface was turned towards the earth, the sun was not more than two degrees below its plane; and during the period embraced by the observations, the depression scarcely ever amounted to one degree. A very moderate density of atmosphere, therefore, might suffice to produce considerable illumination of the obscure surface; much greater, probably, than the reflected light of *Saturn* could give, and of a far *ruddier tinge*, more nearly resembling that of our western sky shortly after sunset.

"3. It was occasionally observed, and on Oct. 6th it is recorded, that the dark shade on the ball was not uniformly black, its *northern* portion being *blacker* than the southern. On three unusually fine nights, viz. Oct. 26th, Oct. 30th, and Nov. 21st, this shade was seen to be divided through its whole length into two parts by an excessively fine bright line. After scrutinising the object for a long time with high powers, I remained perfectly convinced of the fact, which I can account for only by supposing that the northern and blacker portion was the shadow of the ring cast by the sun upon the ball; that the somewhat lighter shade was the ring itself seen projected upon *Saturn*; and that the bright line between the two was a portion of the equatoreal regions of the planet. The relative situations of the different bodies at the time renders, I think, such an explanation probable."

On the Past History of the Comet of Halley. By Mr. J. R. Hind.

It is well known that the periodicity of the remarkable comet which bears the name of Halley was inferred by that astronomer from a comparison of three sets of elements, calculated on observations of the comets of 1531, 1607, and 1682. When his table of cometary orbits was first published, Dr. Halley says he was content to hint at his conjectures respecting the identity of the comets of those years as having some degree of probability, and to advise pos-